Computational Modeling of Flow Control Systems for Aerospace Vehicles, Phase I

Completed Technology Project (2004 - 2004)

Project Introduction

Clear Science Corp. proposes to develop computational methods for designing active flow control systems on aerospace vehicles with the primary objective of controlling lift, drag, and flow separation. Simulated control inputs will include moving boundaries for aerodynamic shaping and aspirating walls for virtual shaping and separation control. The software will include model order reduction, system state estimation, integration of low-dimensional models and estimators with high-order CFD-based models for control-in-the-loop simulations, and the integration of turbulence models with control models. CSC is developing reduced-order flow control models for laminar, incompressible flow based on a proper orthogonal decomposition of the primitive flow variables, and we will extend the methods to compressible formulations with conserved variables and turbulence models. We will develop and demonstrate our computational methods using LaRC's CFD code, CFL3D. Control models and estimators will be modular in the form of both embedded and pre-processing subroutines, enabling off-line and in-the-loop control design and testing. The project will include the application of modeling and estimation techniques to moving-mesh problems for control simulations with time-dependent system disturbances (e.g. changing angles of attack) and wing warping control input. Phase I work includes a demonstration of the technical merit of the tool and the development of a detailed Phase II work plan.

Primary U.S. Work Locations and Key Partners
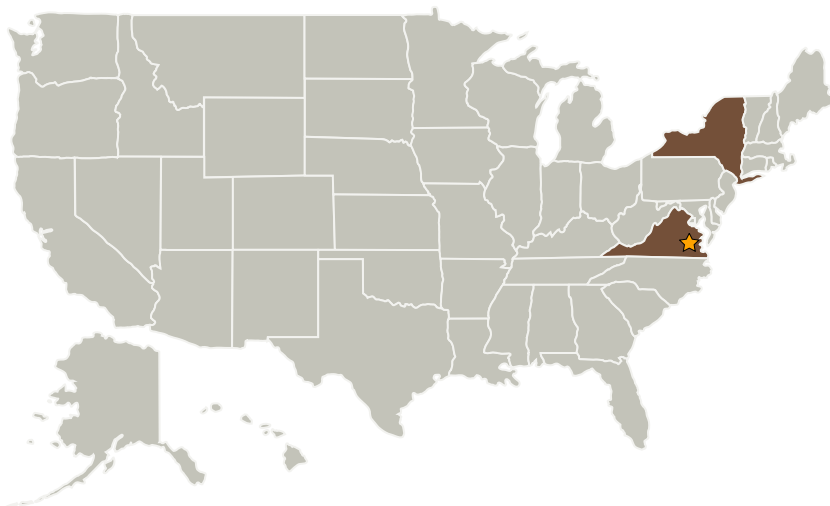
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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

For more information and an accessible alternative, please visit: https://techport.nasa.gov/view/5346

Organizations Performing Work	Role	Type	Location
⭐Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Clear Science Corporation	Supporting Organization	Industry	Harford, New York

Primary U.S. Work Locations	
New York	Virginia

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Henry A Carlson

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  └ TX15.1 Aerosciences
    └ TX15.1.3 Aeroelasticity